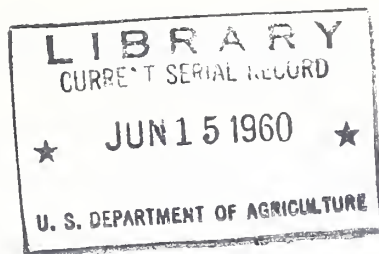


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Studies of

MODIFIED PROTECTIVE

SERVICES FOR RAIL SHIPMENTS

OF BARTLETT PEARS--1959 Season

Market Quality Research Division
Agricultural Marketing Service
UNITED STATES DEPARTMENT OF AGRICULTURE

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June 1960

STUDIES OF MODIFIED PROTECTIVE SERVICES FOR RAIL SHIPMENTS OF BARTLETT PEARS, 1959 SEASON

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SUMMARY AND CONCLUSIONS

Studies of transit temperatures and ripening of California Bartlett pears shipped from California to New York by rail show that--

1. Shipping early-season pears under protective services that provided transit temperatures above 50° F. for a sufficient length of time allowed the initiation of ripening without appreciable changes in firmness, color, or soluble solids content of the fruit between the time of shipment and arrival. This handling method reduced the time required for the fruit to reach an eating ripe state after arrival and facilitated the marketing process by reducing gluts of unripe fruit. Ripening in transit had not progressed enough in any of the test shipments to interfere with the normal marketing of the fruit.

2. To maintain moderate temperatures (50-60° F.) in early-season shipments the ice added at replenishment should be allowed to run out, and the bunkers should be left dry for an interval before further re-icing. Re-icing too soon forces the temperature down below that conducive to the initiation of ripening in transit. Pears warm very slowly in transit after they have cooled, even though the car may have run out of ice.

3. Precooled pears in cars pre-iced to half-stage² capacity and replenished after loading maintained about the same temperatures in transit and ripened at similar rates when re-iced either once or twice in transit. Early-season fruit with temperatures near 70° F. that was shipped without precooling under either of the above protective services required about 6 days to ripen after arrival in New York. This suggests that a single re-icing would be sufficient for such fruit. Fruit loaded at 80° required two re-icings in transit to maintain moderate temperatures.

4. Re-icing early in transit resulted in lower transit temperatures and slower ripening at the market than re-icing late in the transit period with the same number of re-icings.

5. Pears, precooled below 40° F., can be shipped in cars that are pre-iced to half-stage capacity, replenished, and receive one re-icing in transit without appreciable rise in transit temperatures during a 7-day transit period. Use of such a protective service would save \$49.00 per car, if compared with half-stage standard refrigeration, or \$80.49 per car if compared with full-bunker standard refrigeration.

6. Soluble solids content changed very little from the time of harvest, to arrival at market, and to the time the fruit ripened. Color changed very slightly from harvest to arrival at market, but, of course, changed rapidly when the fruit was ripened at 70° F.

BACKGROUND

The initiation of the ripening process in early-season Bartlett pears by providing favorable temperatures for ripening during transit offers an opportunity for improving

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² Special ice grates are in place about midway in each bunker which permit icing the top half of the bunker only.

the quality of the product. This method of shipping also offers a means of reducing market gluts at the beginning of the season, when a high volume of fruit is shipped to market and a low volume is retailed, because of the time required for ripening. Pears will ripen satisfactorily at temperatures between 50° and 75° F., but they ripen with prime quality between 60° and 70° and with poor quality when held above 80° (1, 2, 3).³

In past seasons many tests were conducted (4, 5, 6, 7) to develop modified icing schedules for early pears that would provide transit temperatures favorable to the initiation of ripening. Within the past few years rail schedules from California to New York have been reduced to 7 days from the 9 or 10 days formerly required for delivery. The rapid schedules suggested that fewer re-icings were needed in transit to provide the proper transit temperatures.

Mid-season and late-season pears that were precooled before loading would also be affected by the shortened transit times. The use of half-stage refrigeration and a minimum number of re-icings in transit would result in considerable savings in shipping costs.

Test shipments were initiated, therefore, in the early-, middle-, and late-season pear districts to determine the effect of various icing practices on transit temperatures, initiation of ripening in transit, and subsequent ripening at the market in New York City.

METHODS

Test cars were shipped in pairs to compare the effects of various re-icing practices on temperatures in transit and on fruit ripening. All the test cars were pre-iced before being loaded and were replenished at Roseville, Calif. All were iced to half-stage capacity with 6,000 pounds of ice, with the exception of one full-bunker car shipped late in the season, which was pre-iced with 11,500 pounds of ice. Whenever possible, the paired cars were shipped on the same day to the same market and by the same routing. Protective services, routings, and other test conditions are shown in table 1. Icing records for the test cars are shown in table 2.

Six test packages of pears were placed in each car and three of the packages contained Ryan recording thermometers. The fruit used in the test packages for both cars of the pair was from the same orchard lot to insure uniformity of the samples. All test packages contained size 150 fruit.

Temperatures were taken with the Ryan recording thermometers at the top, middle, and bottom layers of the load at the quarterlength position in order to obtain a representative average temperature of the load.

Examinations of the test packages were made in New York City at the U. S. Department of Agriculture, Market Pathology Laboratory, where the fruit was tested and rated for firmness, color, and soluble solids at arrival and at intervals while being held at 70° F. Similar ratings, of course, had been made at shipping point. Firmness, measured with a Magness-Taylor pressure tester with a 5/16-inch-diameter plunger, was used as the principal index of ripeness in this test. Ground color was rated by comparing the color of the fruit with a Bartlett pear color chart issued by the California State Department of Agriculture with ratings as follows: No. 1, green; No. 2, light green; No. 3, yellowish-green; and No. 4, yellow. Soluble solids content of the test fruit was measured with a hand refractometer.

³ Underscored figures in parenthesis refer to Literature Cited, page 12.

Table 1.--Loading data, protective services and routings of test cars of Bartlett pears, shipped from California districts to New York, N. Y. on indicated dates in 1959

Test car no.	Date 1959	District or county of origin	No. of crates in load	Protective services	Routing ¹
P-3	July 8	Sacramento River	768	Pre-iced, half-stage, replenished, 1 re-icing in transit (Council Bluffs, Iowa)	SP, UP, CMStP&P, Erie
P-4	July 8	Sacramento River	720	Pre-iced, half-stage, replenished, 2 re-icings in transit (Council Bluffs & Marion, Ohio)	SP, UP, CMStP&P, Erie
P-5	July 9	Marysville	720	Pre-iced, half-stage, replenished, 2 re-icings in transit (Ogden, Utah and Council Bluffs)	SP, UP, CMStP&P, Erie
P-6	July 9	Marysville	720	Pre-iced, half-stage, replenished, 2 re-icings in transit (Council Bluffs and Marion)	SP, UP, CMStP&P, Erie
P-7	July 22	Placer Co.	744	Pre-iced, half-stage, replenished, 2 re-icings in transit (Council Bluffs & Marion)	SP, UP, IC, Erie
P-8	July 21	Placer Co.	744	Pre-iced, half-stage, replenished, 3 re-icings in transit (Ogden, Kansas City & Columbus, Ohio)	SP, UP, WAB, Penn.
P-13	Aug. 11	Lake Co.	720	Pre-iced, half-stage, replenished, 1 re-icing in transit (Council Bluffs)	NWP, SP, UP, IC, Erie
P-14	Aug. 11	Lake Co.	744	Pre-iced, half-stage, replenished, 2 re-icings in transit (Council Bluffs & Huntingdon, Pa.)	NWP, SP, UP, C&NW, IHB, Penn.
P-17	Aug. 20	El Dorado Co.	722	Pre-iced, half-stage, replenished, 1 re-icing in transit (Huntingdon)	SP, UP, IC, Penn.
P-18	Aug. 20	El Dorado Co.	727	Pre-iced, full-bunker, replenished, no further re-icing	SP, UP, IC, Penn.

¹ Rail lines abbreviated in accordance with the Official Railway Guide, National Railway Publication Co., New York.

Table 2.--Icing record for test cars of Bartlett pears shipped from California districts to New York, N. Y. in 1959

Test car No. ¹	Days from loading to unloading	Ice added							Total	Ice remaining (estimated)	Total ice melted	Estimated ice used to refrigerate load ²
		Before loading		After loading								
				Pre-ice	Re-ice	Replenish	Re-ice					
		First	Second				Third					
P-3	6-1/2	Lb. 6,000	Lb. 3,200	Lb. 800	Lb. 6,000	Lb. --	Lb. --	Lb. 16,000	Lb. 900	Lb. 15,100	Lb. 10,900	
P-4	6-1/2	6,000	--	4,000	6,000	3,600	--	19,600	2,400	17,200	15,200	
P-5	6-1/2	6,000	--	5,000	4,600	4,700	--	20,300	25	20,275	17,700	
P-6	7-1/4	6,000	--	5,000	6,000	6,000	--	23,000	800	22,200	17,700	
P-7	6-3/4	6,000	--	5,000	6,000	3,000	--	20,000	4,200	15,800	11,900	
P-8	7-3/4	6,000	--	4,800	1,600	6,000	5,900	24,300	2,400	21,900	19,800	
P-13	7-1/2	6,000	--	3,600	2,900	--	--	12,500	200	12,300	11,000	
P-14	7-1/2	6,000	--	3,600	3,600	2,000	--	15,200	4,200	11,000	10,000	
P-17	6-3/4	6,000	--	300	4,200	--	--	10,500	6,000	4,500	2,800	
P-18	6-1/2	11,500	400	400	--	--	--	12,300	4,300	8,000	5,300	

¹ See table 1 for test car protective service, etc.

² Estimate based on calculation of 1 ton ice-meltage per day in empty car before loading. Figures are expressed to nearest 100 pounds.

COMPARISONS MADE AND THE EFFECTS OF PROTECTIVE SERVICES ON TEMPERATURE AND RIPENING

Early-season pears (July 8, 1959) shipped from the Sacramento River District. --A comparison was made of the effect of one and two re-icings in transit on pears shipped from an early-season district, using fruit that had a temperature of about 70° F. at loading. One of the cars (P-3) received one re-icing in transit, at Council Bluffs, Iowa and the other (P-4) received two re-icings in transit, the first at Council Bluffs and the second at Marion, Ohio (tables 1 and 2).

Temperatures of the fruit in both cars remained above 60° F. for about 2-1/2 days in transit and above 50° for 4-1/2 days (fig. 1). The final temperature of the fruit was 43° in the car that received two re-icings and 50° in the car with only one re-icing. Transit temperatures, therefore, were about the same in the two cars, except for the last day of the transit period.

Firmness of the fruit in the test packages averaged 20.5 pounds at harvest and was about 21 pounds in fruit from both cars when it arrived at the New York market. When the fruit was held at 70° F. for ripening at the market, 6 days were required for it to soften to an eating ripe state (about 2 pounds firmness as measured by the pressure tester).

Soluble solids were 10.7 percent at harvest, 12 percent on arrival, and 12 percent when the fruit was ripened, with no consistent difference in fruit from the two cars.

Color of the fruit at harvest was 1.1 and after arrival was 1.5 in the car (P-3) that received one re-icing and 1.4 in the car (P-4) that received two re-icings in transit. This difference was not great enough to be commercially significant.

Comparative costs of the two protective services were \$64.00 for the half-stage pre-iced car that was replenished and received one re-icing and \$82.00 for two re-icings. A saving of \$18.00 was accomplished by reducing the number of re-icings. Cost of the modified schedule with one re-icing was \$49.00 less than that of half-stage standard refrigeration (\$113.00).

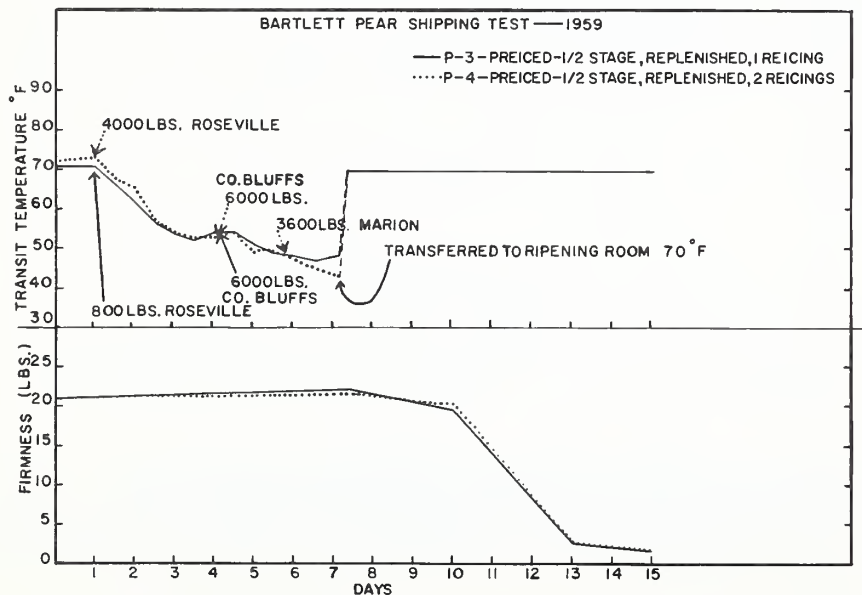


Figure 1. --Early-season Bartlett pears shipped from the Sacramento River District of California to New York, N. Y., July 8, 1959. Pounds of ice added are shown at indicated re-icing stations.

Early-season pears (July 9, 1959) shipped from Marysville District. --A comparison was made of the effect of re-icing cars early in the transit period and late in the transit period. Both cars were re-iced twice in transit, but one car (P-5) was re-iced at Ogden, Utah and Council Bluffs, Iowa, while the other (P-6) was re-iced at Council Bluffs and Marion, Ohio (tables 1 and 2).

The temperature of the fruit was about 80° F. at loading (fig. 2). In the car (P-6) that received the late re-icings the temperature remained above 60° for 7 days in transit, but in the car that received the early re-icings the temperature remained above 60° for only 3 days. Late re-icing resulted in transit temperatures above 50° for the whole period while early re-icing kept the temperature above 50° for only 5 days in transit. Final temperatures at arrival were 60° in the fruit re-iced late in transit and 45° in that re-iced early.

Firmness of the fruit in the test packages averaged 20.5 pounds at harvest and was the same on arrival at market. The fruit in the car that was re-iced early in transit required about 6 days to ripen after reaching market while that re-iced late in transit required only 3-1/2 days.

Soluble solids were 10.9 percent at harvest, 11 percent on arrival, and 12 percent after the fruit was ripened with no consistent difference in fruit from the two cars.

The ground color of the fruit at harvest was 1.1 and after arrival was 1.5 in fruit re-iced late in transit and 1.6 in fruit re-iced early in transit.

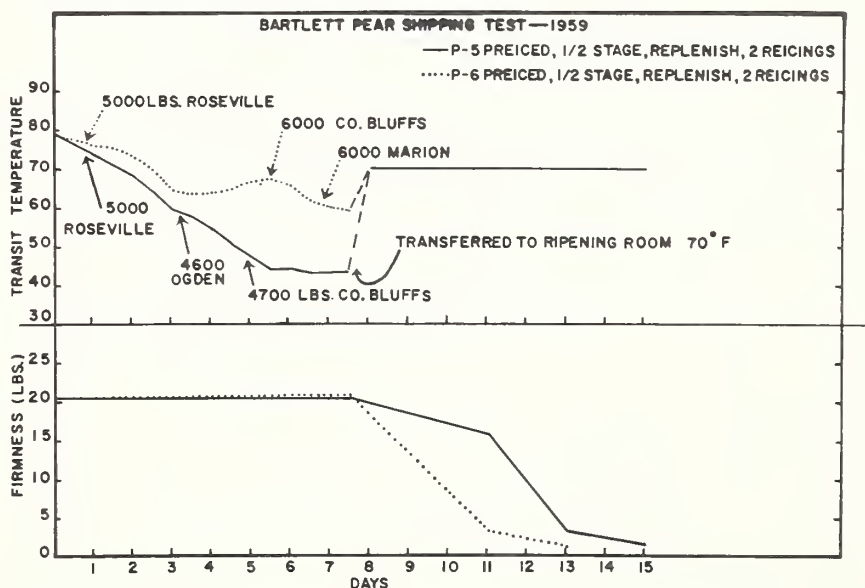


Figure 2. --Early-season Bartlett pears shipped from the Marysville District of California to New York, N. Y., July 9, 1959. Pounds of ice added are shown at indicated re-icing stations.

Mid-season pears (July 21-22, 1959) shipped from Placer County. --A comparison was made between cars shipped with two and with three re-icings in transit. The car (P-7) that was re-iced twice in transit was re-iced at Council Bluffs and Marion while the car (P-8) that was re-iced three times was re-iced at Ogden, Kansas City, and Columbus, Ohio (tables 1 and 2).

Temperature of the fruit averaged 81° F. at loading (fig. 3) and remained above 60° for 5 days in transit in the car that was re-iced twice, but only for 3 days in the car

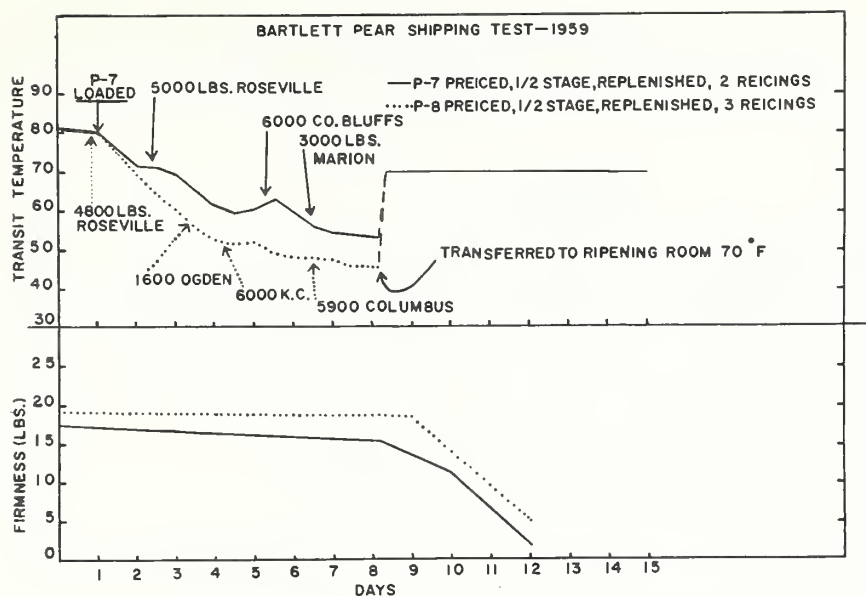


Figure 3. --Mid-season Bartlett pears shipped from Placer County, California to New York, N. Y., July 21-22, 1959. Pounds of ice added are shown at indicated re-icing stations.

re-iced three times. Fruit temperatures were above 50° for the entire transit period in the car with two re-icings and for 5-1/2 days in the car with three re-icings. Final temperatures of the fruit at the end of transit were 55° and 45°, respectively.

Relative ripening rates of the fruit in the two cars cannot be compared directly because loading was delayed in the car with two re-icings and it had to be held over until the day following shipment of the other car. Fruit for the test packages, therefore, had to be taken from different orchard lots.

Firmness of the fruit in the lot placed in the car with two re-icings was 17.5 pounds and that of the fruit in the car with three re-icings was 19 pounds at time of packing. Flesh firmness of the fruit on arrival averaged respectively 15.1 and 18.5 pounds. Fruit in the car that received two re-icings ripened in 4 days after reaching market and that in the car with three re-icings ripened in about 5 days.

Soluble solids in the fruit from lots P-7 and P-8 were 12.0 and 12.7 percent, respectively, at harvest and 13.7 and 14.6 percent on arrival in New York.

Ground color of the fruit in both lots was 1.4 at harvest and was 2.2 in lot P-7 and 1.9 in lot P-8 on arrival in New York.

Comparative icing costs of cars shipped half-stage pre-iced, replenished with two or three re-icings in transit were \$82.00 and \$93.00, respectively. Cost of the service with two re-icings was \$11.00 less than that with three re-icings and \$31.00 less than half-stage standard refrigeration.

Mid-season pears (August 11, 1959) shipped from Lake County. --Pears harvested in Lake County are usually precooled to about 34° to 38° F. before loading. Considerable savings could be accomplished by substituting modified icing schedules for standard refrigeration of the precooled loads. A comparison was made between cars re-iced one or two times in transit. Both cars were pre-iced to half-stage capacity and were replenished. The car (P-13) that was re-iced once in transit was re-iced at Council Bluffs and the car (P-14) that was re-iced twice was re-iced at Council Bluffs and Huntingdon, Pa. (tables 1 and 2).

Temperatures at loading averaged about 36° F. in both cars and remained below 40° during the entire transit period (fig. 4).

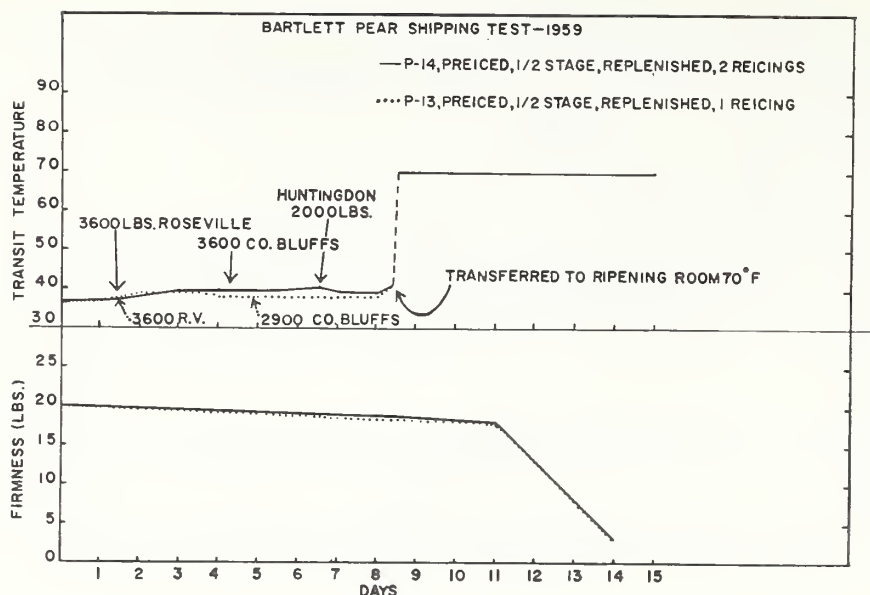


Figure 4. --Mid-season Bartlett pears shipped from Lake County, California to New York, N. Y., August 11, 1959. Pounds of ice added are shown at indicated re-icing stations.

Firmness of the fruit in the test packages was 19.7 pounds at harvest and 18.1 pounds on arrival at market. The fruit from both cars required 5-1/2 days to ripen after reaching the market.

Soluble solids at harvest were 12.4 percent and on arrival were 13.8 percent in fruit from the car receiving one re-icing and 13.4 percent in that from the car with two re-icings. Soluble solids in fruit from both cars was 13.3 percent when the fruit was ripened.

Ground color of the fruit at harvest was 1.9 and on arrival was 1.8 in fruit from the car with one re-icing and 1.7 in that from the car with two re-icings. These differences were not of commercial significance.

The cost of shipping pears under half-stage refrigeration with replenish and one re-icing in transit was \$49.00 less than half-stage standard refrigeration and \$80.49 less than full-bunker standard refrigeration (\$144.49).

Late-season pears (August 20, 1959) shipped from El Dorado County. --A comparison was made of precooled pears shipped in a pre-iced, half-stage car (P-17) with replenish and one re-icing in transit and a pre-iced full-bunker car (P-18) with replenish and no further re-icing. The car that received one re-icing in transit was re-iced at Huntingdon, Pa. (tables 1 and 2).

Temperatures of the fruit at loading averaged 32° F. and remained below 40° in the half-stage car for the entire trip (fig. 5). In the full-bunker car that was not re-iced the temperature remained below 40° for all, but the last 2 days in transit. Final fruit temperatures on reaching New York were 36° and 42°, respectively, in the two cars.

Ice remaining in the car shipped half-stage with one re-icing in transit was almost 6,000 pounds while that in the car shipped full-bunker with no re-icings was about 4,300 pounds (table 2).

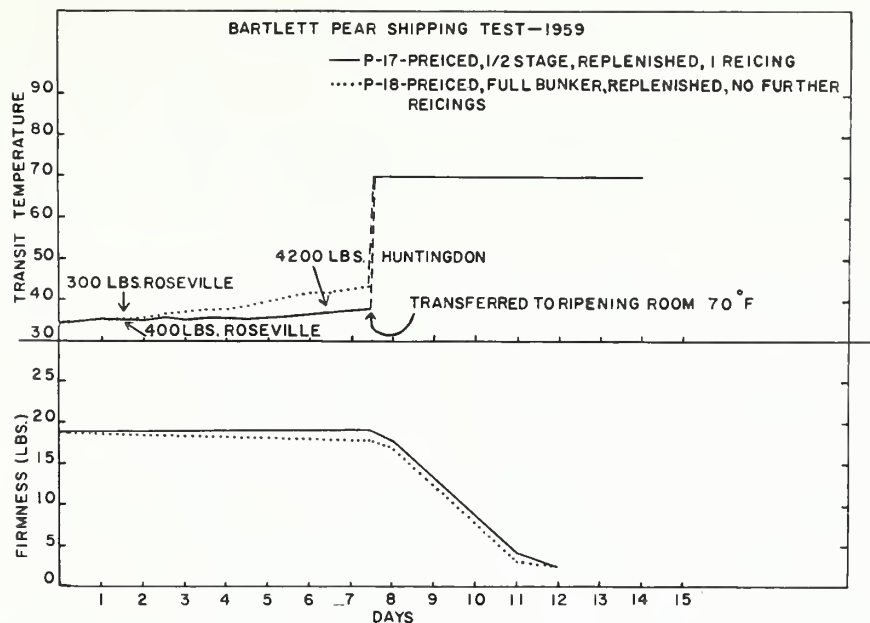


Figure 5. --Late-season Bartlett pears shipped from El Dorado County, Calif., to New York, N. Y., August 20, 1959. Pounds of ice added are shown at indicated re-icing stations.

Firmness at harvest was 18.7 pounds in fruit from the test packages. On arrival the firmness was 18.7 pounds in the half-stage car and 17.6 pounds in the full-bunker car. Fruit from both cars required about 5-1/2 days to ripen to an eating ripe state after reaching New York.

Soluble solids contents of the fruit were 12.3 percent at harvest and 12.8 percent on arrival of both cars. When the fruit was ripened soluble solids were 12.9 percent in fruit from the half-stage car and 12.4 percent in that from the full-bunker car.

Ground color of the fruit was 2.2 at harvest and 1.6 on arrival in test packages from both cars. The apparent reversal in color development was probably due to variation in the particular fruit samples. The difference in the color rating taken at harvest and after arrival at market was slight.

The cost of shipping pears under half-stage refrigeration with one re-icing in transit was \$80.49 less than the cost of full-bunker standard refrigeration and the icing charge for a full-bunker pre-iced car, replenished, with no re-icings in transit was \$82.49 less than full-bunker standard refrigeration.

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